THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Daniel J. Woodruff, et al.

Application No.: 10/084,962

Confirmation No.: 2206

Filed: February 27, 2002

Title: ELECTROPLATING APPARATUS WITH SEGMENTED ANODE ARRAY

Art Unit: 742

Examiner: Donald R. Valentine

Docket No.: 114183-7 (P98-0040US2)

DECLARATION UNDER 37 C.F.R. § 1.131
OF DANIEL J. WOODRUFF AND KYLE M. HANSON

We, Daniel J. Woodruff and Kyle M. Hanson, hereby declare and say that:

We are the inventors of the subject matter disclosed and claimed in the above-identified application, having made the invention described therein in the United States. We conceived and reduced to practice the subject matter of the claims in this application prior to April 21, 1998, the earliest filing date claimed by U.S. Patent No. 6,261,433 ("the '433 patent).

2. To demonstrate such prior conception and reduction to practice, we attach hereto as Exhibit A our Invention Disclosure for the concentric anode array reactor and, as Exhibit B our Invention Record describing the anode

configuration, both forming the basis for the drawings contained in the above-identified application. Exhibit A, naming ourselves as inventors thereof, was prepared and signed by us well prior to April 21, 1998 and lists dates of conception and written description also prior to April 21, 1998. In addition, Exhibit A was witnessed and understood by two colleagues at Semitool, Inc., also prior to April 21, 1998.

3. Exhibit B which we both signed was also prepared prior to April 21, 1998 and witnessed before that same date. Together, Exhibits A and B were used in the preparation of the drawings contained in the present application, thus establishing conception of the method and apparatus disclosed in the above-identified application prior to April 21, 1998.

4. The segmented anode described in the present application is shown in Semitool engineering drawings, Exhibits C, D. E, F, G, H and I, just as described in the present application. The drawings of Exhibits C-I were each made prior to April 21, 1998 and were used to construct the segmented anode at the facility of Semitool, Inc. in Kalispell, Montana. That segmented anode was built, installed in a plating reactor as described in the present application and shown in Exhibits A and B, and that apparatus was successfully tested prior to April 21, 1998.

5. The dates contained on each of the exhibits have been removed, but all are prior to April 21, 1998, and thus corroborate conception and reduction to practice of the subject matter disclosed and claimed in the present application.

6. hereby declare under the penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge and belief.

7. Further declarants sayeth not.

Executed this 23rd day of March, 2005 in Kalispell, Montana.

Daniel J. Woodruff

Kyle M. Hanson

INVENTION DISCLOSURE

SEMITOOL, INC. D 0006

Note:
1. Use Ink or Type Only
2. Do not erase errors. Line through any errors, initial and date.
3. Describe invention with drawings, sketches, etc. and a written explanation. Drawings may be below or attached. If attached, the inventor(s) and witnesses must sign and date each sheet.
4. Describe the advantages of this invention compared to the current approach, if any.
5. Inventor(s) and two (2) witnesses must sign and date each sheet.
6. Send original signed documents to the Intellectual Property Department. Retain a personal copy.

Inventor(s) Name and Social Security Number

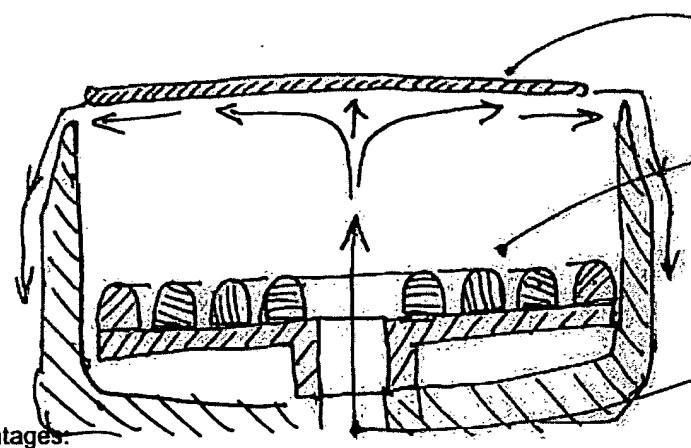
Daniel J. Woodruff
Kyle M. Hanson

Title of Invention: TOOL: Plating

Concentric Anode Array with Centered Fluid Flow

Invention:

Sketch



Explanation and Advantages:

Plating fluid is pumped through the center of the anode array and impinges on the wafer surface. The plating rate on the wafer surface will vary radially ~~across the~~ due to the effect of the impinging fluid on the hydrodynamic boundary layer. This radial effect can be compensated for ~~it by the~~ by operating the anode rings at different electrical potentials.

(continued on attached sheet)

Signature(s) of Inventor(s):	Date:	Date of Conception:	Date of First Sketch/Drawing:
Daniel J. Woodruff Kyle Hanson			
Witnessed and Understood By:	**Date:**	**Date of Written Description:**	**Working Model Prepared?**
Tom L Ritzdorf R W Cox			Yes/No Date:

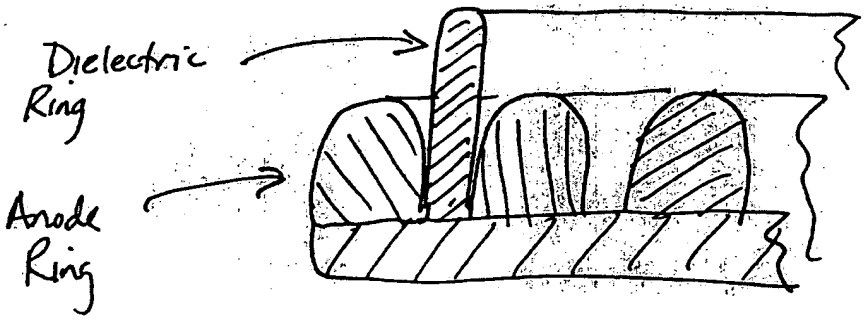
Blumberg No. 5118

EXHIBIT

A

Explanation and Advantages (Cont.)

In addition to affecting plating uniformity by using different anode potentials it would also be possible to affect uniformity with dielectric (insulating) material placed between the anode ring (see sketch



The geometry of the dielectric material could be modified to provide the desired effect on plating. Tall geometries would tend to limit interaction of adjacent anodes (and perhaps collimate current flow to the wafer) while shorter or perforated geometries would tend to increase anode interaction. Similar effects may also be possible by positioning the anode rings at varying distances from the water surface.

The advantages to this design are:

1) No diffuser is required between the anode and wafer. Fluid flow rate and current distribution can be controlled independent of one another in the proposed design, but can't in the existing system which uses a diffuser constructed of dielectric material. Having these variable independently controllable makes it easier to optimize the plating process.
2) Air bubbles introduced into the plating chamber by the incoming fluid flow are simply flushed passed the wafer surface and won't interfere with the plating process. With the existing system utilizing a diffuser these bubbles can attach to the diffuser surface and adversely impact diffuser performance
3) Fluid flow through the center of the anode ensures the wafer surface will be wetted from the center out. This will prevent air being trapped at the center of the wafer when it first contacts the fluid surface

Daniel J. Woodruff

INVENTION DISCLOSURE

DI -0005

SEMITOOL, INC.

Note:
1. Use Ink or Type Only
2. Do not erase errors. Line through any errors, initial and date.
3. Describe invention with drawings, sketches, etc. and a written explanation. Drawings may be below or attached. If attached, the inventor(s) and witnesses must sign and date each sheet.
4. Describe the advantages of this invention compared to the current approach, if any.
5. Inventor(s) and two (2) witnesses must sign and date each sheet.
6. Send original signed documents to the Intellectual Property Department. Retain a personal copy.

Inventor(s) Name

KYLE M. HANSON HENRY . STEVENS
CHRIS K. HAUGAN DANIEL J. WOODRUFF

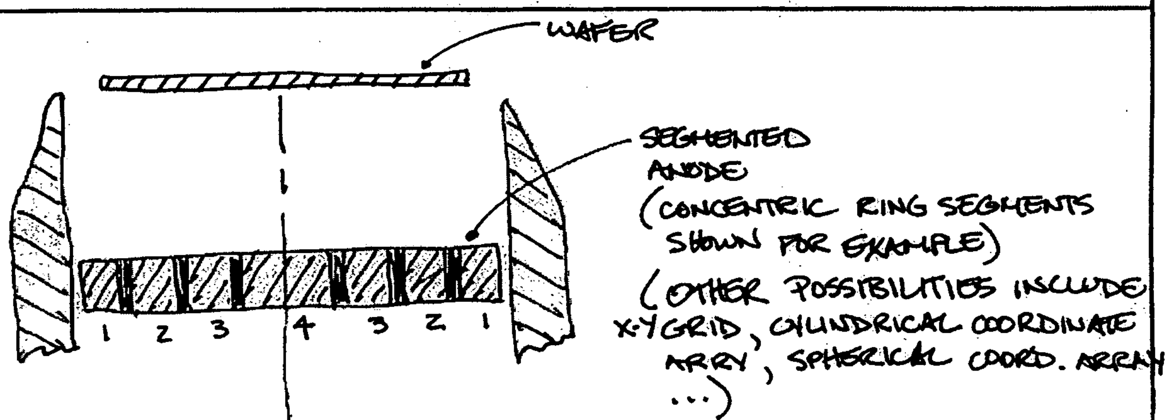
Tool or Process: ELECTRO CHEMICAL DEPOSITION

Title of Invention:

ANODE CONFIGURATION DYNAMIC CONTROL

Invention:

Sketch



Explanation and Advantages:

Thru the use of a segmented anode structure and independent electrical control on each of these segments (definition of voltage or current flow), the capability to dynamically modify the anode configuration is enabled. This allows for optimization of the anode and therefore reactor current flow in order to compensate for the transient

Signature(s) of Inventor(s):	Date:	Date of Conception:	Date of First Sketch/Drawing:

Witnessed and Understood By:	Date:	Date of Written Description:	Working Model Prepared?
			Yes (No)
			Date:

EXHIBIT

B

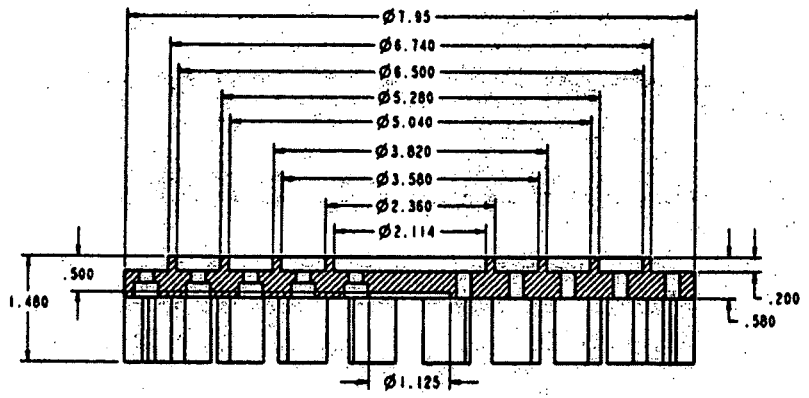
Blumberg No. 5118

Explanation & Advantages (Con't)

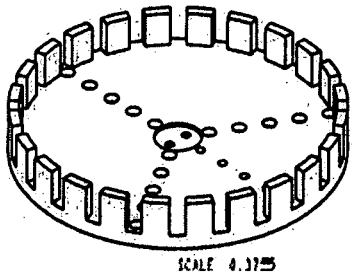
effects from the plated film growth on the wafer. As this film grows on the wafer the current distribution on the wafer will change due to the difference in the films electrical conductivity.

This capability to dynamically alter the anode configuration as the process progresses is becomes more important in the case of high resistance seed layers. In this case, the transient change in the film characteristics is made larger in magnitude as a layer of high electrical conductivity copper, for example, is deposited on a much lower conductivity layer

The [illegible] pattern sensitivity [illegible] plating [illegible] and [illegible] sensitive F.1 characteristic [illegible] other feature density related electrochemical response for plated local current density at the wafer surface [illegible] attached to local feature density, be used the potential applied to each anode segment [illegible] be individually controlled



SECTION A-A



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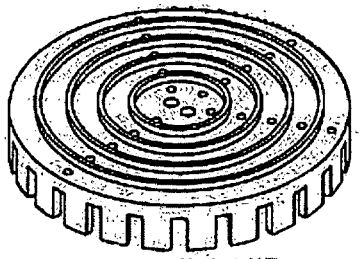

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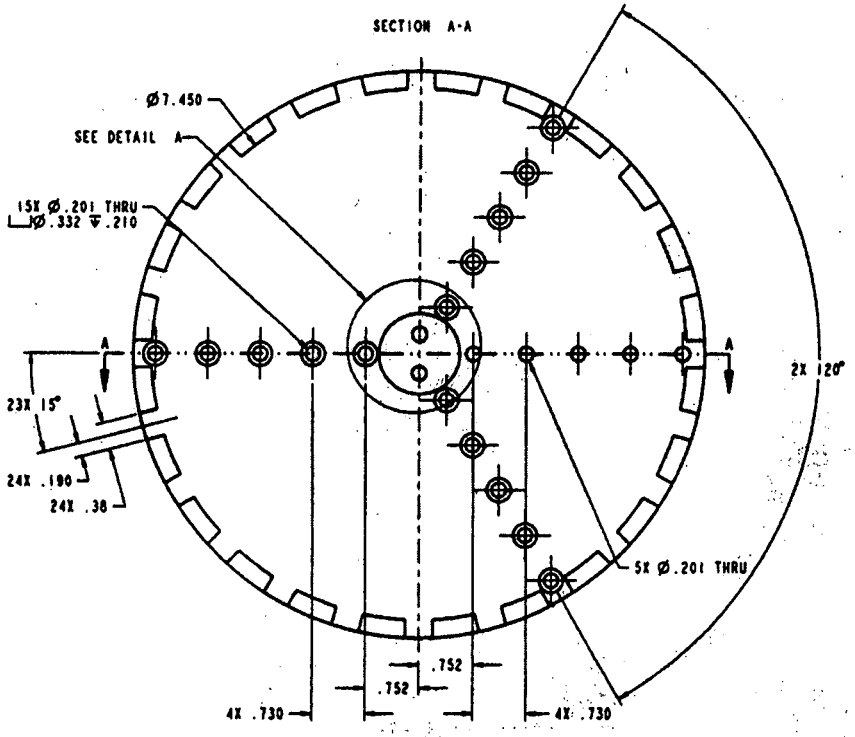
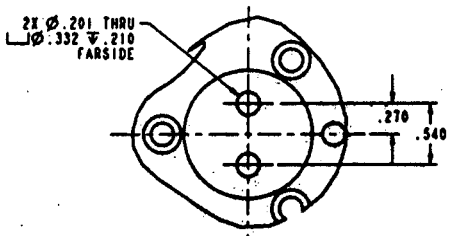




DETAIL A
SCALE 1.000

REVISIONS					
REV	DIST	DESCRIPTION	ELEVATION	DATE	APVD
A		REDESIGN			DJV

SEMITOOL PROPRIETARY

MATERIAL	HPP, SHEET 1 5/8"
FINISH	
DWG NO	ATG0234

SEMITOOL KALISPELL, MT

MOUNT, ANODE, VARIABLE ARRAY

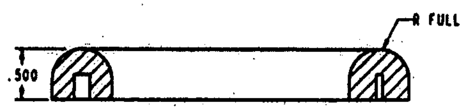
SIZE	DWG NO	REV
B	ATG0234	A

SCALE 0.375 SHEET 1 of 1

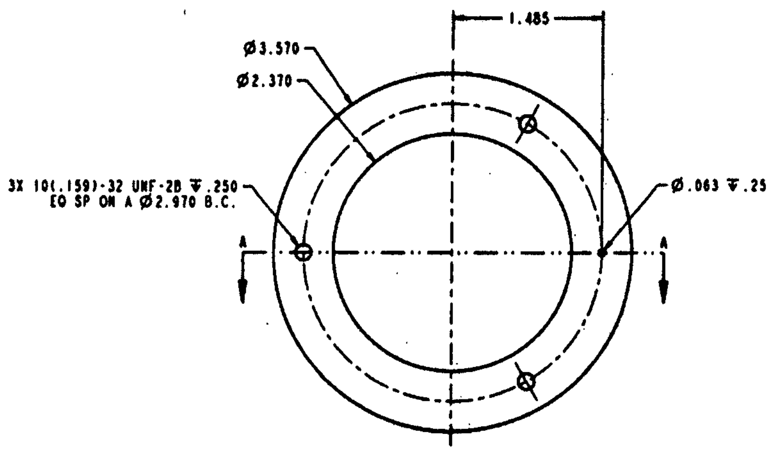
Blumberg No. 5118

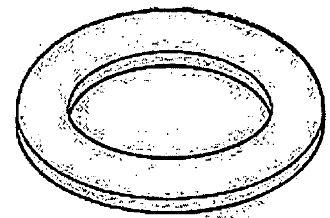
EXHIBIT C

REV	ECO	DESCRIPTION			
A		REDESIGN			



SECTION A-A





SCALE: 0.750

NOTES:

1. CHEMICAL COMPOSITION

	PERCENT %
*COPPER	99.90 MIN.
PHOSPHOROUS	0.045 TO .06
IRON	0.003 MAX.
SULFUR	0.003 MAX.
LEAD	0.002 MAX.
ANTIMONY	0.002 MAX.
NICKEL	0.002 MAX.
ARSENIC	0.001 MAX.
TOTAL OTHER	0.01 MAX.

*SILVER COUNTED AS COPPER

2. MATERIAL CERTIFICATION TO BE PROVIDED WITH RAW MATERIAL.

MATERIAL: COPPER, PHOSPHOROUS CONTENT .045-.06%

ATG0235.

SEMITOOL™ KALISPELL, MT

ANODE, RING, 2.97 DIA.

B ATG0235 A

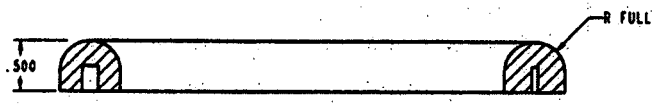
SCALE 0.875

SEMI-TOOL PROPRIETARY

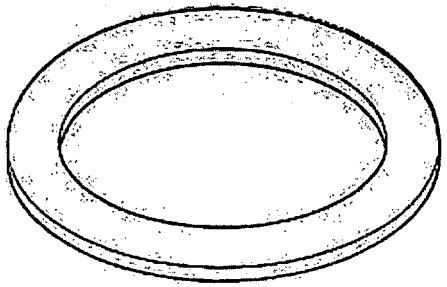
EXHIBIT D

Blumberg No. 5118

REVISIONS				
REV	DIST	DESCRIPTION	DESTRUCTION	APPROVED
A		REDESIGN		



SECTION A-A



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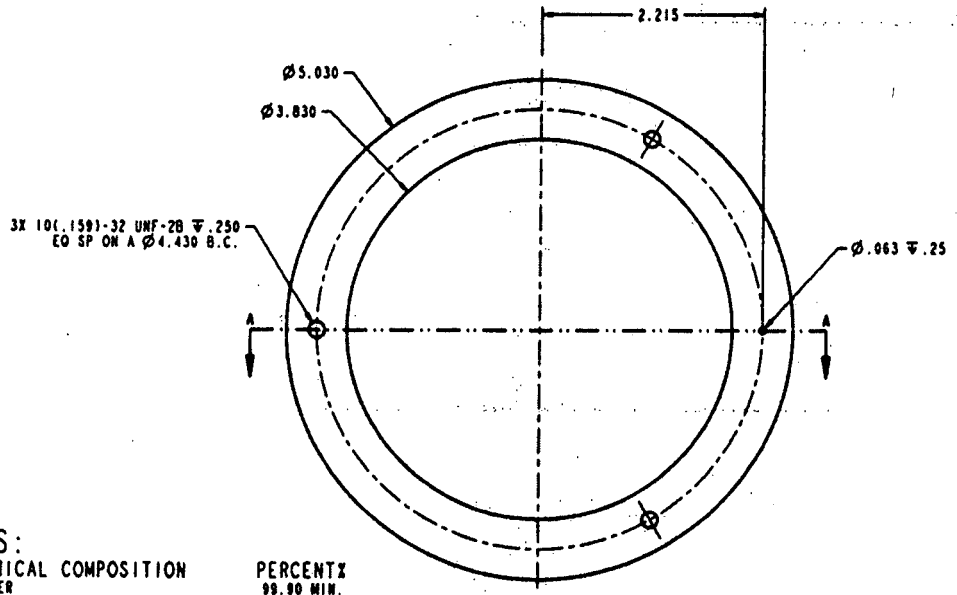


NOTES:

1. CHEMICAL COMPOSITION

	PERCENT%
*COPPER	99.90 MIN.
PHOSPHOROUS	0.045 TO .06
IRON	0.003 MAX.
SULFER	0.003 MAX.
LEAD	0.002 MAX.
ANTIMONY	0.002 MAX.
NICKEL	0.002 MAX.
ARSENIC	0.001 MAX.
TOTAL OTHER	0.01 MAX.

*SILVER COUNTED AS COPPER

2. MATERIAL CERTIFICATION TO BE PROVIDED WITH RAW MATERIAL.

MATERIAL	COPPER, PHOSPHOROUS CONTENT .045-.065
FINISH	
MODEL NO.	ATG0236

SEMITOOL™ KALISPELL, MT

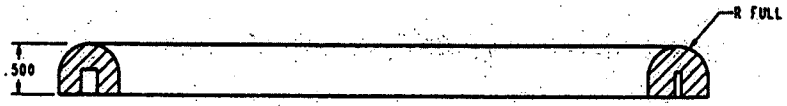
ANODE, RING, 4.43 DIA.

SIZE	DWG. NO.	REV
B	ATG0236	A

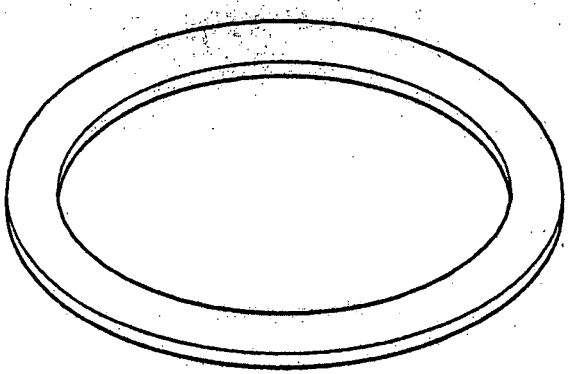
SCALE 0.375 SHEET 1 of 1

SEMITOOL PROPRIETARY

REVISIONS				
REV	DIST	DESCRIPTION	DESIGNATION	APPRVD
A		REDESIGN		D.M.



SECTION A-A



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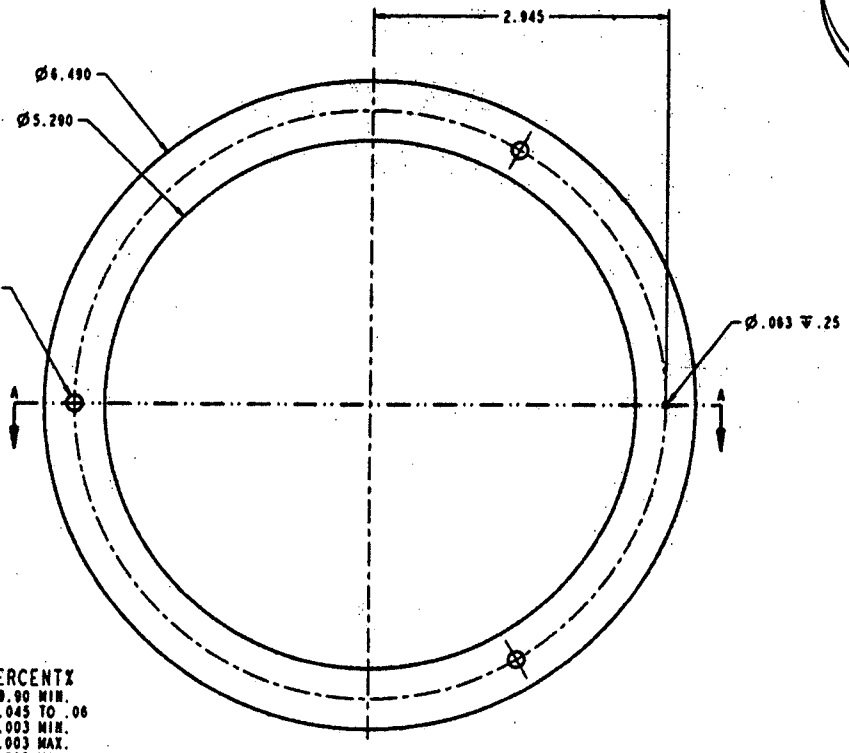


NOTES:

1. CHEMICAL COMPOSITION

	PERCENT%
*COPPER	99.90 MIN.
PHOSPHOROUS	0.045 TO .06
IRON	0.003 MIN.
SULFER	0.003 MAX.
LEAD	0.002 MAX.
ANTIMONY	0.002 MAX.
NICKEL	0.002 MAX.
ARSENIC	0.001 MAX.
TOTAL OTHER	0.01 MAX.

*SILVER COUNTED AS COPPER

2. MATERIAL CERTIFICATION TO BE PROVIDED WITH MATERIAL.

MATERIAL	COPPER, PHOSPHOROUS CONTENT .045-.065
FINISH	-
NEXT ASSY	ATG0237

SEMITOOL™ KALISPELL, MT

ANODE, RING, 5.89 DIA.

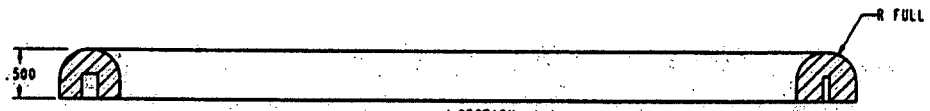
SIZE	DWG NO.	REV
B	ATG0237	A

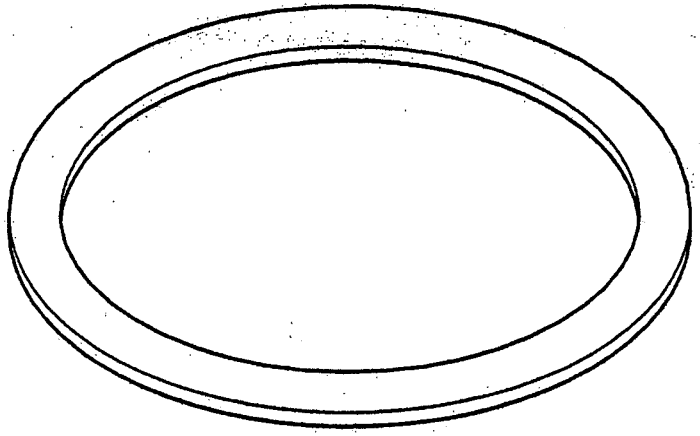
SCALE 0.375 | SHEET 1 of 1

SEMITOOL PROPRIETARY

Blumberg No. 5118

EXHIBIT F





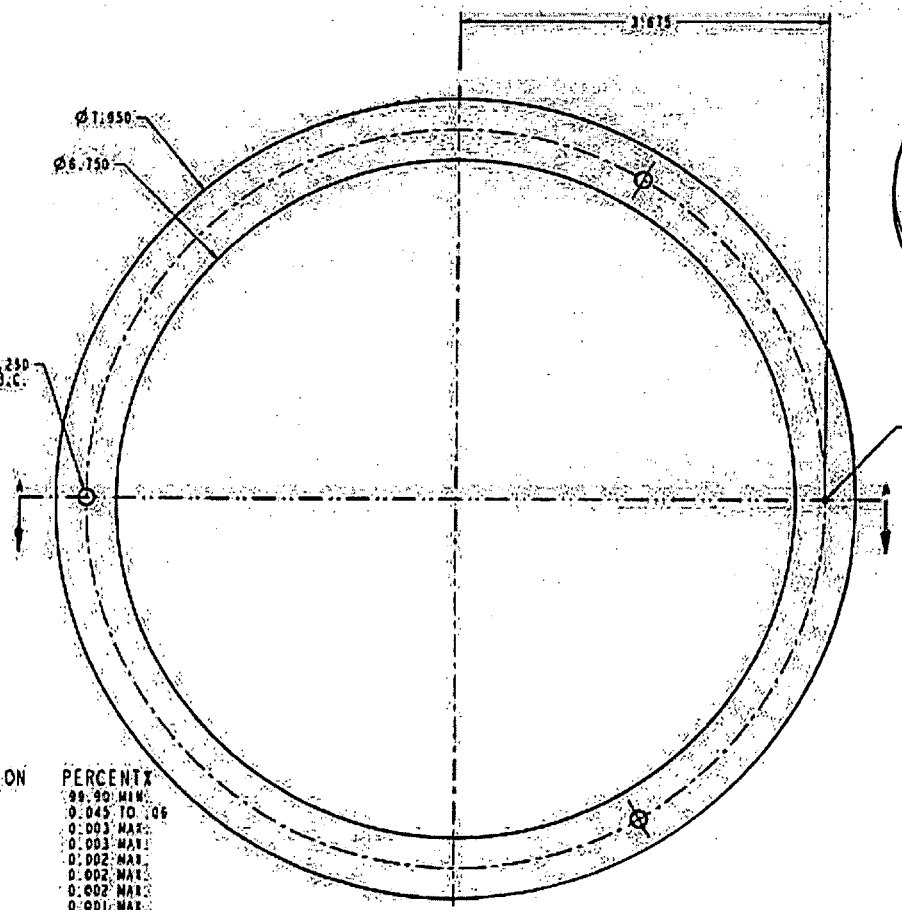


EXHIBIT
G
Blumberg No. 5118

NOTES:

1. CHEMICAL COMPOSITION

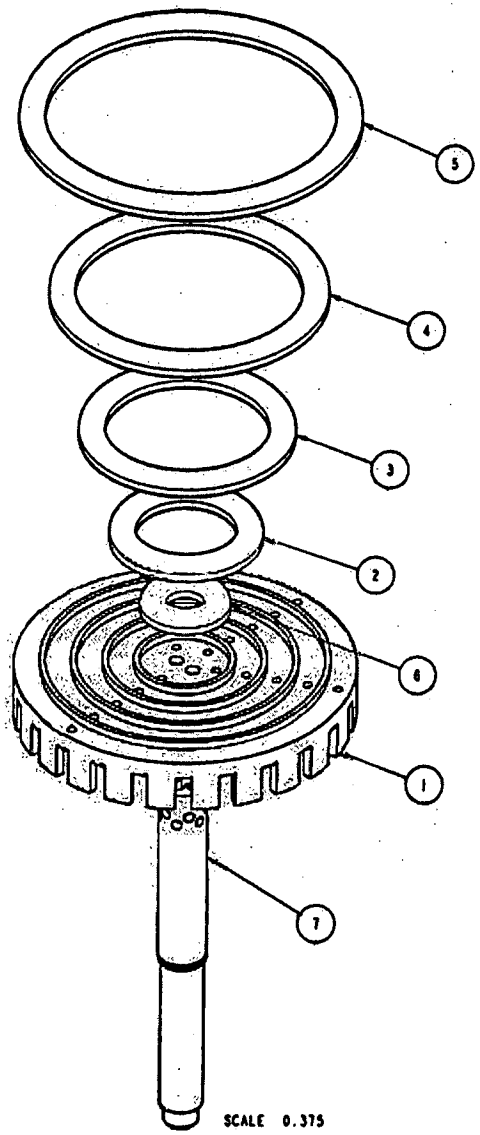
	PERCENT
COPPER	99.90 MIN.
PHOSPHOROUS	0.045 TO .06
IRON	0.003 MAX.
SULFER	0.003 MAX.
LEAD	0.002 MAX.
ANTIMONY	0.002 MAX.
NICKEL	0.002 MAX.
ARSENIC	0.001 MAX.
TOTAL OTHER	0.01 MAX.

*SILVER COUNTED AS COPPER

2. MATERIAL CERTIFICATION TO BE PROVIDED WITH RAW MATERIAL.

SEMITOOL PROPRIETARY

COPPER, PHOSPHOROUS CONTENT .045-.060
ATG0238
SEMITOOL
ANODE, RING, 7.35 DIA.
B
ATG0238
A



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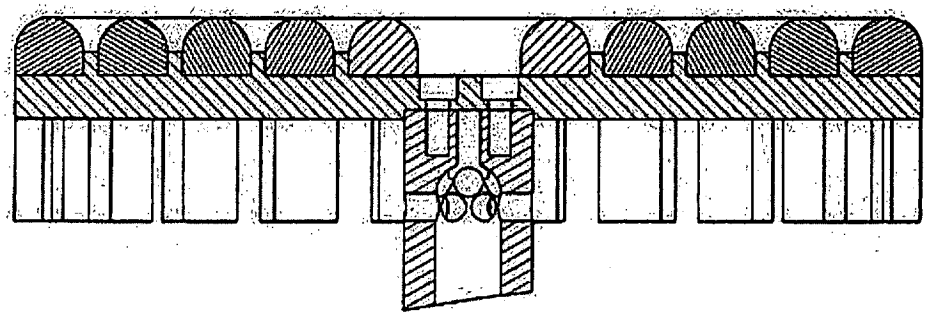
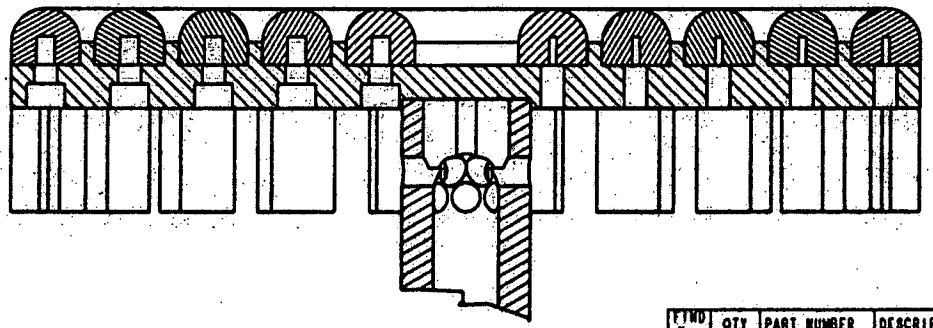


SECTION D-D



SECTION C-C

FIND No.	QTY	PART NUMBER	DESCRIPTION
1	1	ATG0234	MOUNT, ANODE, RADIAL ARRAY
2	1	ATG0235	ANODE, RING, 2.97 DIA.
3	1	ATG0236	ANODE, RING, 4.43 DIA.
4	1	ATG0237	ANODE, RING, 5.89 DIA.
5	1	ATG0238	ANODE, RING, 7.35 DIA.
6	1	ATG0356	ANODE, RING, 2.97 DIA.
7	1	ATG0357	POST, ANODE CONSUMABLE NOT PLATED

SEMITOOL™ KALISPELL, MT

ANODE ASSEMBLY, VARIABLE ARRAY

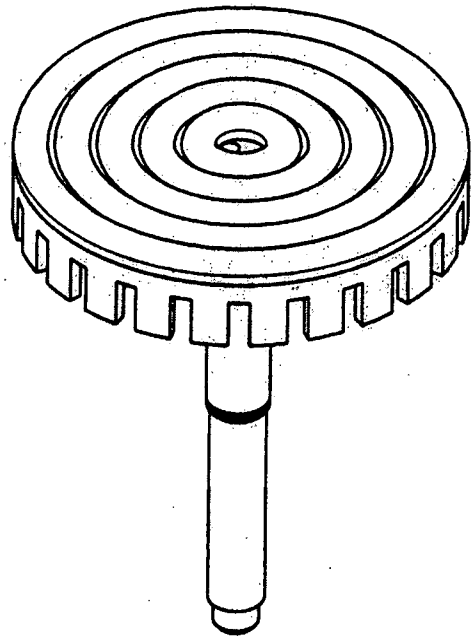
SIZE B | ATG0233 | REV

SCALE 1.000 | SHEET 1 of 2

SEMITOOL PROPRIETARY

EXHIBIT H

Blumberg No. 5116



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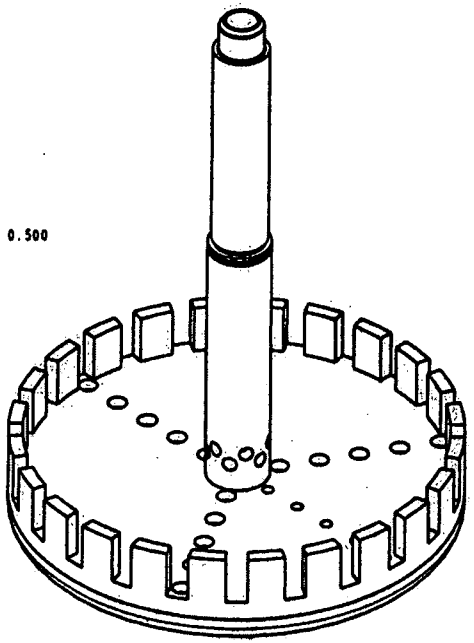

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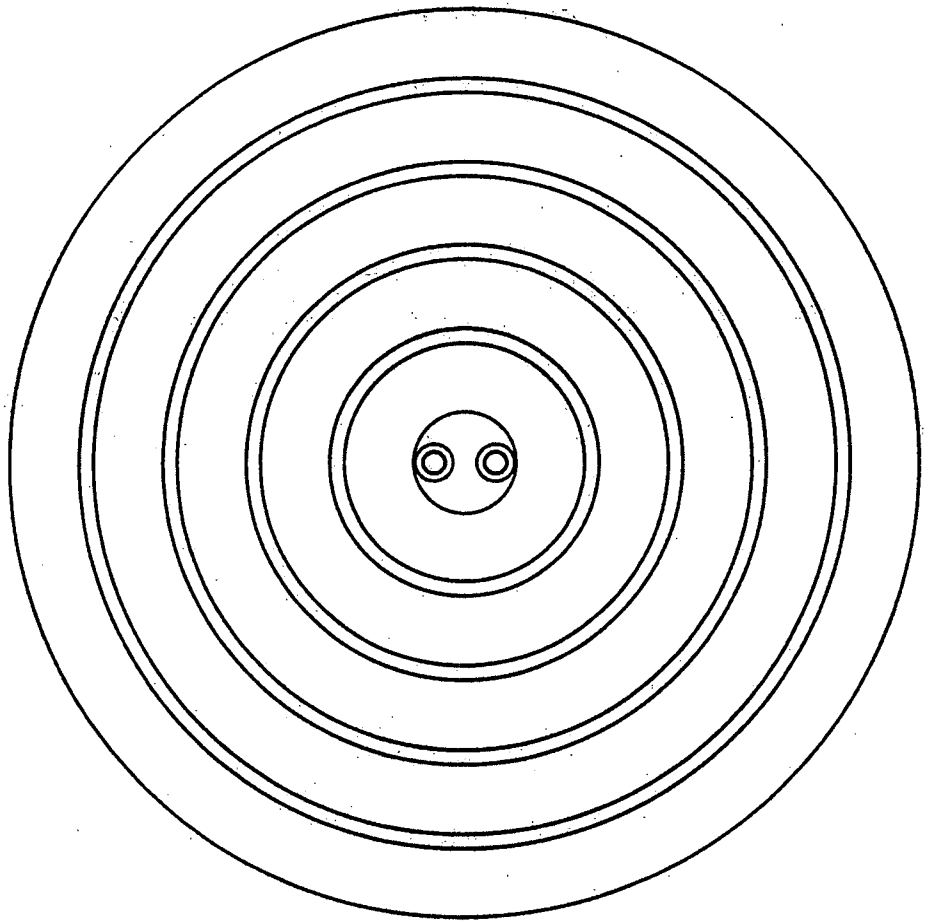

SEMITOOL PROPRIETARY

B

AT00233

Blumberg No. 5118

EXHIBIT

I